

### **LISTING OF THE CLAIMS**

*The listing of claims will replace all prior versions and listings of claims in the application:*

#### **Listing of Claims:**

1.     **(Original)**     A vertical cavity surface emitting laser, comprising:  
  
          a substrate;  
  
          a first mirror stack over the substrate;  
  
          an active region having a plurality of quantum wells over the first mirror stack;  
  
          a tunnel junction over the active region, a p-layer of the tunnel junction including GaPSb or AlGaPSb; and  
  
          a second mirror stack over the tunnel junction.
  
2.     **(Original)**     A vertical cavity surface emitting laser according to claim 1, wherein an n-layer of the tunnel junction further includes a compound selected from the group consisting of InP, AlInAs, AlInGaAs, InGaAs and InGaAsP.
  
3.     **(Original)**     A vertical cavity surface emitting laser according to claim 1, further including an n-type spacer adjacent the active region, and wherein the first mirror stack is an n-type DBR.

4.     **(Original)**     A vertical cavity surface emitting laser according to claim 1, further including an p-type spacer adjacent the tunnel junction, and wherein the second mirror stack is an n-type DBR.

5.     **(Original)**     A vertical cavity surface emitting laser according to claim 1, further including:

an n-type bottom spacer adjacent the active region, and wherein the first mirror stack is an n-type DBR; and

an p-type top spacer adjacent the tunnel junction,

wherein the first and second mirror stacks are each an n-type DBR.

6.     **(Original)**     A vertical cavity surface emitting laser according to claim 1, wherein the p-layer is grown by MOCVD or MBE.

7.     **(Original)**     A vertical cavity surface emitting laser according to claim 6, wherein the MOCVD grows the p-layer of the tunnel junction using TMAI, TMGa, TMSb and PH<sub>3</sub> in a temperature range between about 400 °C and about 900 °C.

8.     **(Original)**     A vertical cavity surface emitting laser according to claim 6, wherein the MBE grows the p-layer of the tunnel junction at a condition where the Equivalent Beam Pressures of group V sources are in a range of about  $1 \times 10^{-7}$  to about  $1 \times 10^{-3}$  torr and the growth rates of group III sources are less than about 10 μm/hour.

9.     **(Original)**     A vertical cavity surface emitting laser according to claim 6, wherein the p-layer is doped with carbon with a concentration greater than about  $2 \times 10^{18} \text{ cm}^{-3}$ .

10.    **(Original)**     A vertical cavity surface emitting laser according to claim 1, wherein the active region includes one of InGaAs, InGaAsP and AlInGaAs.

11.    **(Original)**     A vertical cavity surface emitting laser according to claim 1, wherein the first and second mirror stacks are lower and upper mirror stacks, respectively.

12.     **(Original)**     A tunnel junction having a p-layer including GaPSb or AlGaPSb.
  
13.     **(Original)**     A tunnel junction according to claim 12, wherein the p-layer is doped with carbon with a concentration greater than about  $2 \times 10^{18} \text{ cm}^{-3}$ .
  
14.     **(Original)**     A tunnel junction according to claim 12, further including an n-doped layer of a compound in the group consisting of InP, AlInAs, InGaAs, AlInGaAs, and InGaAsP.
  
15.     **(Original)**     A tunnel junction according to claim 14, wherein the n-doped layer is doped with a concentration greater than about  $2 \times 10^{18} \text{ cm}^{-3}$ .
  
16.     **(Original)**     A tunnel junction according to claim 14, wherein the n-doped layer is less than about 100 nanometers thick.
  
17.     **(Original)**     A tunnel junction according to claim 14, wherein the n-doped layer is doped with a concentration greater than about  $2 \times 10^{18} \text{ cm}^{-3}$  and the n-doped layer is less than about 100 nanometers thick.

18. **(Original)** A long wavelength VCSEL, comprising:  
an indium-based semiconductor substrate;  
a first mirror stack over the substrate;  
an active region having a plurality of quantum wells over the first mirror stack;  
a tunnel junction over the active region, wherein a p-layer of the tunnel junction includes GaPSb or AlGaPSb; and  
a second mirror stack over the tunnel junction.

19. **(Original)** A long wavelength VCSEL according to claim 18, wherein an n-layer of the tunnel junction further includes a compound selected from the group consisting of InP, AlInAs, InGaAs, AlInGaAs and InGaAsP.

20. **(Original)** A long wavelength VCSEL according to claim 18, further including an n-type spacer adjacent the active region, and wherein the first mirror stack is an n-type DBR.

21. **(Original)** A long wavelength VCSEL according to claim 18, further including an p-type spacer adjacent the tunnel junction, and wherein the second mirror stack is an n-type DBR.

22. **(Original)** A long wavelength VCSEL according to claim 18, further including: an n-type bottom spacer adjacent the active region, and wherein the first mirror stack is an n-type DBR;

and an p-type top spacer adjacent the tunnel junction, wherein the first and second mirror stacks are each an n-type DBR.